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Does the Bobath approach improve trunk control in acute stroke patients?

Bobath-based trunk training in acute stroke patients

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Abstract
Aim: In this study, we aimed to examine the effect of Bobath-based trunk training on improving trunk control in acute stroke patients.
Material and Methods: A total of 81 stroke patients were randomized to the control (n=41) or experimental group (n=40). Then, the groups were divided into two subgroups, moderate and severe, according to disease severity using the Modified Rankin Scale (mRS). Experimental subgroups received Bobath-based trunk training 5 days a week for 1 hour a day during hospitalization. Control subgroups received a conventional physiotherapy program 5 days a week for 1 hour a day during hospitalization. Sitting ability was evaluated as independent or dependent according to sitting time. Trunk control was assessed with the Trunk Impairment Scale (TIS) and the trunk subscale of Motor Assessment Scale (MAS-T). Balance was assessed with Berg Balance Scale (BBS). Functional activity level was assessed with the motor subscale of Functional Independence Measurement (FIM-M). Comparisons between groups were made according to the severity of the disease, and the moderate subgroups were compared with each other, and the severe subgroups with each other.
Results: Trunk control, sitting ability and balance improved significantly more in the experimental moderate and severe subgroups than in the control subgroups according to TIS ($p<0.05$), MAS-T ($p<0.05$), BBS ($p<0.05$) and FIM-M scores ($p<0.05$).
Discussion: Bobath-based trunk training improved sitting ability, trunk control, balance and functional independence in acute stroke patients regardless of initial disease severity.

Keywords
Stroke, Rehabilitation, Bobath Approach, Trunk

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Introduction

After a stroke, trunk impairment is prevalent and causes various difficulties in activities such as speaking, breathing, and lower and upper extremity functions [1]. It is also one of the important indicators of recovery and is associated with length of hospital stay, balance, walking, functional mobility, and activities of daily living (ADL) [2].

Stroke affects trunk muscles multidirectionally, unlike extremity muscles [3]. Moreover, altered trunk position sense also affects trunk control after stroke [4]. Trunk exercises are used to improve trunk control in stroke patients. Previous studies [5,6] demonstrated that sitting training, trunk-oriented exercises, core stabilization exercises, and balance exercises increase trunk control in subacute and chronic stroke patients.

Another method used in trunk training is the Bobath approach, which is widely used in stroke rehabilitation worldwide. Despite its widespread use, this approach appears to be utilized as an experimental or conventional method for improving trunk control in chronic stroke patients in a few studies [7-9].

The extremities and trunk recovered after the stroke with a similar time course. Verheyden et al. [10] investigated the recovery process in the trunk and extremities and indicated that the improvements were at the highest level in the first month. Although the first one-month acute period seems to be a very appropriate period to develop trunk control, studies on improving trunk control in this period are very limited. Karthikbabu et al. [11] examined the effects of physio ball and plinth trunk exercise regimens on trunk control in acute stroke patients and determined that trunk control increased in both groups, but training on the ball was more effective. Although Bobath is the most common stroke management approach, it has been used in very few studies, especially in the acute period. As a result of these studies, different results have been obtained regarding the effectiveness of this approach [12]. In the literature, although there is no consensus on the effectiveness of the Bobath approach, it is the most used stroke treatment approach in clinics. In addition, in the acute stroke phase, the improvement of the trunk positively affects various functions in the chronic stroke phase. Therefore, our study was planned to examine the effect of Bobath-based trunk training on improving trunk control in acute stroke patients with different disease severity.

Material and Methods

Design and Patients

This study was an assessor-blinded, randomized controlled trial performed at the neurology inpatient service at Hacettepe University Hospital, Turkey. The study was approved by the local ethical committee of Hacettepe University (KA-16073) and was registered in the Clinical Trials Registry (CTR number: NCT03429855). Patient recruitment started in March 2018 and ended in October 2019.

Inclusion criteria were having first stroke attack, age over 18 years, Glasgow coma scale (GCS)≥14, absence of cognitive impairment, that is, Mini-Mental State Examination >24, being within the first week after stroke onset and at stage ≥2 according to the Modified Rankin Scale (mRS). Exclusion criteria comprised recurrent strokes, other neurologic diseases, severe orthopedic problems or communication disorders that may affect the results. Patients with posterior circulation stroke were also excluded.

The patients were randomly divided into the experimental and control subgroups. The randomization was performed using a random number table. To allocate patients to one of these groups, physical therapists who were blinded to the research performed assignments based on a computer-generated random number. Then, the experimental group was divided into two subgroups according to mRS. The Severe Disability subgroup (S-EG) included patients with severe deficiency (mRS score ≥4) and the Moderate Disability subgroup (M-EG) included patients with moderate deficiency (mRS score ≤3). Similarly, the control group was divided into the Severe Disability subgroup (S-CG) and the Moderate Disability subgroup (M-CG).

Interventions

Patients in the control group (M–CG and S–CG) received the conventional physiotherapy program, which was tailored to the individual needs of patients 5 days a week for 1 hour a day during hospitalization. The program included a range of motion exercises, general strengthening and stretching exercises, balance and gait training. In the experimental group (M–EG and S–EG), the Bobath based physical therapy program was tailored to the individual needs of patients 5 days a week for 1 hour a day during hospitalization [9]. Trunk control training comprised approximately 50-60% of each session. Experienced physiotherapists took part in the identification of functional limitations and in stroke rehabilitation during the development and validation of the hypotheses. The treatment program intensively concentrated on trunk control in all directions. Treatment programs for both groups are summarized in Table 1.

Outcome Measurements

The patients were assessed on the first day when their medical condition was stable after hospitalization. Disease severity was assessed with mRS. The Trunk Impairment Scale (TIS) and trunk part of the Motor Assessment Scale (MAS-T) were used to determine the trunk control of all patients. The balance was evaluated using the Berg Balance Scale (BBS), functional activity level with a motor section of the Functional Independence Measurement (FIM-M) and sitting time without support was recorded. The tests were repeated on the day of discharge by the same physiotherapist who performed the initial assessment and was blinded to the groups.

To evaluate sitting ability, the patients were asked to sit with back unsupported, without using hands on the edge of a bed. The thighs made full contact with the bed, the hip and knees flexed ninety degrees, the feet were hip width apart and placed flat on the floor. The arms were crossed over the chest. The head and trunk were in a midline position. The sitting time was recorded during the standard sitting position. If the position changed or patients maintained their position for more than two minutes, the test was ended. Patients who were able to maintain the standard sitting position for two minutes or more were classified as independent and others as a dependent.

Trunk control was evaluated with TIS and MAS-T. TIS consists of 3 subscales: static and dynamic sitting balance and trunk coordination, scored up to 7, 10, and 6 points, respectively. The total scores range between 0 and 23 points, where a higher score indicates better trunk function. MAS-T contains rolling, lie to sit, and sitting balance. Each item is scored on a 7-point ordinal scale from 0 to 6, a higher score indicating a better performance [13].

BBS is a functional balance test. It includes 14 items and all of them are scored on a 5-point ordinal scale from 0 to 4, with a maximum score of 56 points. A higher score indicates better balance ability [14].

The degree of disability or dependence in daily activities was evaluated using mRS. It describes "global disability" with a focus on mobility. The mRS is an ordered scale coded from 0 (no symptoms at all) to 5 (severe disability) and 6 (death). Level 3 and lower values indicate moderate and less disability, while Levels 4 and 5 indicate severe disability [15]. For this reason, these values were considered when structuring the subgroups.

FIM-M was used to evaluate the ability to perform ADL. The FIM-M item scores range from 1 (total assistance required) to 7 (complete independence). A higher score indicates a greater degree of independence with regard to ADL [16].

Data analysis

Analyzes were performed separately for subgroups. Descriptive measures were summarized as mean±standard deviation or percentage. The Chi-square test was used for categorical variables. The Shapiro-Wilk test was used to determine the distribution of variables. Wilcoxon's signed ranks tests were used for group analyses, and the Mann–Whitney U test was used to compare different groups according to distribution. The initial disability level scores of the patients in the subgroups and any potential differences in recovery rates were considered. For this reason, severe subgroups were compared to one another, while moderate subgroups were compared to one another. All statistical analyses were performed using the SPSS v.18 with a significance level of $p<0.05$.

The sample size calculation was based on the study of Karthikbabu et al. [11] (the post-hoc TIS scores of the plinth and control group) for our primary outcome and was conducted using G-power 3.1 (Heinrich Heine University, Dusseldorf, Germany). To determine the appropriate sample size, the effect size was set to 0.852 with 95% power to identify between-group differences in before–after intervention changes, with an α error of 0.05. The calculation indicated that 39 participants were required per group; 44 participants per group were recruited to allow for dropouts.

Ethical Approval

Ethics Committee approval for the study was obtained.

Results

A total of 108 patients were screened for study eligibility and 88 patients met the inclusion criteria. The patients were randomly allocated to groups. The study was completed with 81 patients. Figure 1 shows a CONSORT flowchart stating the steps of the study. In the analyzes, it was seen that the experimental and the control group were homogenous in terms of demographic and clinical characteristics (Table 2).

Treatment processes of all patients were completed without any side effects. The scores of TIS, MAS-T, BBS and FIM-M increased significantly in all subgroups after interventions compared to pretreatment except for value of TIS static part for M-CG and TIS dynamic part for S-CG ($p<0.001$ for all comparisons). Sitting ability developed in both S-EG and S-CG (respectively $p<0.001$ and 0.008). In addition, the scores of TIS, MAS-T, BBS and FIM-M improved significantly in Bobath subgroups compared to control subgroups ($p<0.05$ for all comparisons) (Table 3).

Discussion

Our study showed that Bobath-based trunk training applied to stroke patients in the acute phase improves sitting ability, trunk control and balance more effectively than conventional physiotherapy regardless of the severity of the disability. Although the systematic reviews reported that the Bobath approach had no superiority over other methods used in stroke patients regaining mobility, motor control, gait, sitting and standing balance [12,17-19], our results did not support the literature findings. There may be some possible reasons for this discrepancy. Firstly, our study was intended to directly improve trunk control, while the reviews included a very limited number of studies focusing on the trunk, and secondly, the chosen by reviews trunk control measurement tools varied. Lastly, it may be due to the inclusion of patients in the acute phase in our study.

The sitting ability and trunk control were evaluated within the scope of our study. The number of patients who could sit independently increased significantly in the experimental group compared to the control group. In the literature, core stability training, which includes exercises such as bridge building, upper and lower trunk flexion, extension and rotation, and various weight bearing trainings are used to increase trunk control. These practices were also effective in improving sitting balance [1]. Although the training provided to the experimental group did not follow all the principles of core stability training with a specific protocol, it seems to include similar exercise practices. Considering that the role of sensorimotor control is much more important than that of strength or endurance of the trunk muscles for balance [20], the Bobath approach may have contributed to trunk control by improving sensorimotor control as well.

Turning in the bed, evaluated by using MAS-T in our study, is one of the milestones of normal development and basic ADL. In stroke patients, turning towards the unaffected side is impaired [21]. Kafri and Dickstein [21] showed in their study that the relationship between the pectoralis major and the rectus femoris, external obliques is impaired due to decreased activation on the hemiplegic side in stroke patients.

The treatment applied to the experimental subgroups may have contributed to the higher scores of these subgroups on MAS-T by providing the correct sensory input and adjusting the movement sequence.

In our study, it was observed that TIS scores increased in all sub-parameters and total scores in the study group. Unlike other studies conducted to improve trunk control [7, 22], there was also an increase in the static balance score of the TIS.

This may be due to the fact that the studies generally specified

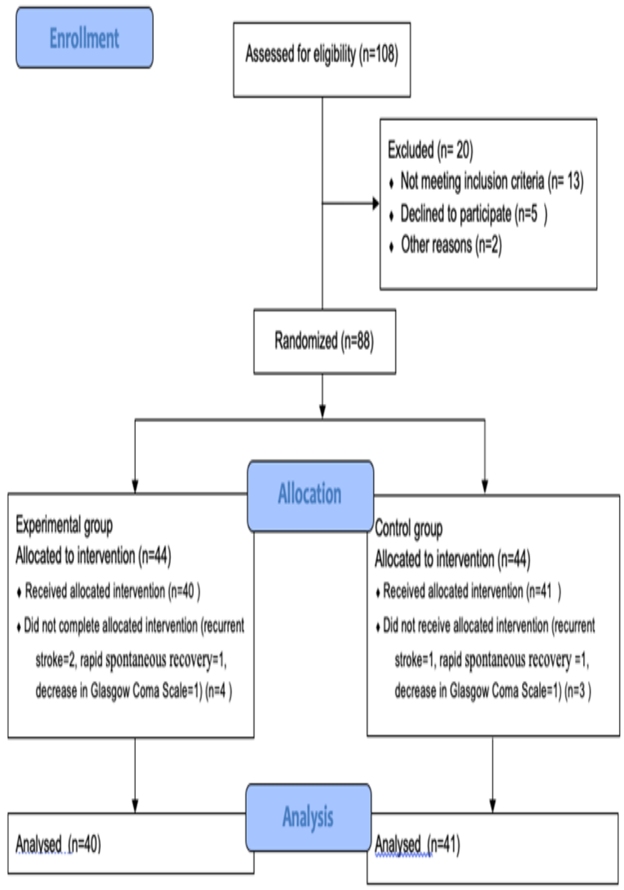

Figure 1. Flow chart

the ability to sit independently for more than 10 seconds, which is sufficient to receive a full score on the static balance section of the scale, as an inclusion criterion, and included chronic stroke patients who are likely to sit already. The inclusion of acute patients in our study may have allowed the scale to show the post-treatment change in this population.

Previous studies show that trunk training improves BBS scores [7,23]. Similarly, the scale's scores increased in our study. The increase in transfer activities and the improvement in sitting and standing activities together with the increase in sitting balance of our patients in the study group may have improved the scores.

The FIM-M scores in the study subgroups improved more than in the control subgroups in our study. Likhi et al. [24] reported that the overall functional independence in acute stroke patients is most closely correlated with trunk function, followed by upper limb impairments.

Considering the relationship between independence in ADL and trunk control in stroke patients, it could be said that the improvement in ADL in our study is due to the recovery in trunk control.

The study has some limitations. There was no follow-up after discharge within the scope of the study. For this reason, it cannot be commented on how long the obtained treatment effects will last. In addition, the effect of improvement in trunk control on other functions has not been examined and since inpatients were included in the study, the level of independence of the patients in their daily living activities may not have been fully demonstrated. Therefore, FIM values should be interpreted with caution.

Table 1. Treatment programs for groups

	Severe Group	Moderate Group
Experimental Group (To stimulate normal trunk movement patterns, improve the quality of trunk movements, facilitate active trunk movements by normalizing muscle tone in the trunk, and avoid compensatory movements in the trunk, all exercises were carried out in accordance with the Bobath Concept)	Positioning in bed	The exercises for the lower & upper extremities (in sitting position)
	The exercises for the lower & upper extremities (in bed)	Mobilization (Scapular & Lumbosacral area)
	Mobilization (Scapular & Lumbosacral area)	Lengthening of the latissimus dorsi in sitting position
	Lengthening of the latissimus dorsi in the supine position	Bridging exercises
	Strengthening the back extensors and abdominal muscles (with inner range applications)	Strengthening the back extensors and abdominal muscles (in bed and in sitting position)
	Bridging exercises	Weight bearing exercises in sitting & standing positions
	Turning in bed	Correcting pelvis position in sitting position and standing actively
	Placing exercises for sitting	Postural realignment exercises (especially in the thoracolumbar area)
	Correcting pelvis position in a sitting position (by supporting it with a material such as a sacral wedge or towel)	Sit-to-stand exercises
		Functional reaching in sitting position
		Balance training in sitting and standing positions
		Gait training
Control Group (Programs were designed to improve balance, stimulate motor recovery, and adapt to the new functional condition)	Positioning in bed	Exercises for the lower & upper extremities in supine & sitting positions (passive, active assistive, active or resistive)
	Range of motion exercises for extremities (passive, active assistive or active)	Bridging exercises
	Bridging exercises	Balance training in the sitting and standing position
	Transfer training	General strengthening exercises
	General strengthening exercises	Stretching/weight-bearing by the affected arm
	Stretching the affected arms (for tone modulation)	Sit-to-stand exercises
	Sitting passively	Balance training
		Gait training
		Teaching of activities of daily living using the less-affected side

Table 2. Demographic and clinical features

	Experimental Group		Control Group		p values	
	M-EG n=11	S-EG n=29	M-CG n=14	S-CG n=27	M-EG M-CG	S-EG S-CG
Age (year) mean±SD (min-max)	65.81±10.69 (42-77)	65.31±8.18 (53-78)	66.21±9.20 (43-78)	66.22±11.24 (50-78)	0.851†	0.511†
Physiotherapy sessions (times) mean±SD (min-max)	11.09±4.30 (7-20)	12.41±5.00 (7-20)	11.57±4.10 (7-19)	13.00±4.53 (7-20)	0.647†	0.760†
Disease duration (day) mean±SD (min-max)	3.27±1.19 (2-6)	3.27±1.27 (1-5)	2.57±0.93 (1-4)	3.25±1.31 (1-6)	0.134†	0.705†
Body Mass Index (kg/m^2) mean±SD (min-max)	28.97±4.83 (21.63-35.38)	28.68±4.59 (18.37-38.29)	28.97±1.73 (25.81-31.91)	28.50±2.16 (25.10-34.48)	0.848†	0.688†
Gender						
Male [n (%)]	8 (72.7)	14 (48.3)	14 (51.9)	5 (35.7)	0.111‡	0.999§
Female [n (%)]	3 (27.3)	15 (51.7)	13 (48.1)	9 (64.3)		
Dominant side						
Left [n (%)]	9 (81.8)	28 (96.6)	14 (100)	26 (96.3)	0.183‡	0.999‡
Right [n (%)]	2 (18.2)	1 (3.4)	0 (0.0)	1 (3.7)		
Affected side						
Left [n (%)]	5 (45.5)	17 (58.6)	10 (71.4)	16 (59.3)	0.241§	0.961‡
Right [n (%)]	6 (54.5)	12 (41.4)	4 (28.6)	11 (40.7)		
Sitting ability						
Sitting [n (%)]	11 (100)	4 (13.8)	14 (100)	4 (14.8)	-	0.913‡
Not-sitting [n (%)]	0 (0.0)	25 (86.2)	0 (0.0)	23 (85.2)		
Modified Rankin Scale [n (%)]						
Level 2-3	11 (100)	0 (0.0)	14 (100)	0 (0.0)	-	-
Level 4-5	0 (0.0)	29 (100)	0 (0.0)	27 (100)		

SD: standard deviation, min: minimum, max: maximum, n: sample size, bold: p<0.05, M-EG: moderate experimental group, S-EG: severe experimental group, M-CG: moderate control group, S-CG: severe control group, kg: kilogram, m^2: square meters, †: Mann Whitney U Test, §: Chi-square Test, ‡: Chi-square Test with Fisher 's Exact Test

Table 3. Comparison of the functional outcome measurements pre-and post-interventions within and between groups

	Experimental Group				Control Group				P between groups	
	M-EG (n=11)	P within group	S-EG (n=29)	P within group	M-CG (n=14)	P within group	S-CG (n=27)	P within group	Moderate	Severe
TIS mean±SD										
Static										
Pre	5.45±1.75	0.026*	2.48±2.08	<0.001*	4.85±1.40	0.084*	2.29±2.12	0.034*	0.264†	0.677†
Post	6.81±0.40		5.17±1.89		5.28±1.58		3.14±1.99		0.002†	0.001†
Dynamic										
Pre	4.81±0.87	0.003*	1.89±2.16	<0.001*	3.78±2.22	0.028*	2.00±2.20	0.341*	0.070†	0.561†
Post	7.90±1.04		5.27±2.50		4.71±3.04		2.30±2.49		0.016†	<0.001†
Coordination										
Pre	1.72±1.55	0.011*	0.27±0.45	<0.001*	1.42±1.39	0.039*	0.25±0.65	0.015*	0.652†	0.383†
Post	4.18±0.98		2.03±1.49		2.35±1.98		0.66±1.03		0.008†	<0.001†
Total										
Pre	13.09±3.67	0.005*	4.55±3.96	<0.001*	9.92±4.48	0.005*	3.29±4.54	<0.001*	0.057†	0.159†
Post	18.90±1.97		12.44±4.99		12.78±0.67		6.14±4.95		0.004†	<0.001†
BBS mean±SD										
Pre	29.36±10.32	0.003*	2.07±5.54	<0.001*	27.42±9.00	0.001*	1.44±2.54	<0.001*	0.351†	0.622†
Post	38.09±7.68		11.58±7.62		32.64±9.62		4.74±4.67		0.048†	<0.001†
MAS-T mean±SD										
Pre	12.54±2.25	0.005*	5.34±2.88	<0.001*	10.92±2.64	0.004*	5.59±3.23	<0.001*	0.100†	0.816†
Post	16.18±1.77		10.82±3.68		13.07±3.95		7.22±3.77		0.042†	0.001†
FIM-M mean±SD										
Pre	41.18±12.25	0.003*	16.58±4.47	<0.001*	35.35±16.88	0.001*	16.88±8.09	<0.001*	0.380†	0.449†
Post	57.27±9.48		35.10±7.94		44.78±15.06		23.55±8.54		0.048†	<0.001†
Sitting Ability [sitting n (%)]										
Pre	11 (100)	-	4 (13.8)	<0.001§	14 (100)	-	4 (14.8)	0.008§	-	-
Post	11 (100)		25 (86.2)		14 (100)		14 (51.9)		-	0.008§

SD: standard deviation, min: minimum, max: maximum, n: sample size, bold: p<0.05, M-EG: moderate experimental group, S-EG: severe experimental group, M-CG: moderate control group, S-CG: severe control group, TIS: Trunk Impairment scale, Pre: pre-intervention, Post: post-intervention, BBS: Berg Balance Scale, MAS-T: Motor Assessment scale trunk subscale, FIM-M: Functional Independence Measurement motor subscale, †: Mann Whitney U Test , §: Chi-square Test, *: Wilcoxon Sign Test

Conclusion

In conclusion, the Bobath approach may be a viable treatment option for the development of trunk control regardless of the disability level of the patients in the acute period after stroke. The effectiveness of the Bobath-based trunk training in the severely affected group is one of our most important study findings. Since most of the studies on practices that have been shown to be effective in the literature preferred to include individuals who have reached a good level in their studies rather than individuals with serious disabilities. In our study, on the other hand, individuals with severe effects were not excluded, and as a result of our study, satisfactory results were obtained in this group as well. Our study suggested that perhaps the Bobath approach is not as ineffective as reported by systematic reviews in regaining mobility, balance, and ADL. It may still be an appropriate approach that could be prioritized for patients with at least some disability levels. In further studies, the long-term effects of Bobath-based trunk training may be examined. In addition, the effects of improvement in trunk control on other functions may be examined.

Scientific Responsibility Statement
The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement
All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Conflict of interest
The authors declare no conflict of interest.

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